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myself too near them, the flying egret would give a loud, shrill call, and they would all rise up immediately and be gone for perhaps an hour. I frequently disturbed them, and so uniform was their action at such a time that I could exactly describe in advance to a friend what would be their movements when I alarmed them. So unvarying was their method of leaving and returning to the meadow that it seemed only explicable by considering it the predetermined routine, resulting from a consultation had among them when circumstances first led them to the spot in question.

As an instance, also, of these birds apparently "studying the situation," I daily noticed a change in their habits as the waters began to subside and restricted their range of submerged land. They seemed to know full well that an open meadow, six or eight inches under water, afforded no "cover" for their arch-enemy, man, but that he might crawl dangerously near in the long, tangled grass, now again exposed. The indication of this supposed train of thought on the part of the herons consisted in their increased suspicion, and the steadily increasing number of circular flights on the part of some of their number to see if any danger was near by.

It were useless to endeavor to give a detailed account of their many interesting movements, all of which were so indicative of genuine *thought*; but the whole series of observations, as I now recall them, and the perusal of my field-notes, more than ever fully convince me that these egrets, like all birds, depend upon, and are successful in life, I may say, more from their reasoning powers and their quality than they trust to or are dependent upon the operations of instinct.

THE HOUSE FLY.

BY A. S. PACKARD, JR.

A BRIEF history of the common house fly, which abounds to such an annoying extent in August, may not be out of season, especially as until within two or three years we were quite in the dark as to its mode of life and transformations. The *Mémoires* of the Swedish count, DeGeer, published just one hundred years ago, contain the first notice of the house fly, while a fuller account is given in an obscure book by Bouché, a German entomologist, published in 1834. Two years ago the writer made a special study of the mode of growth and life-history of the fly,¹ the leading points of which are here reproduced.

¹ On the Transformations of the Common House Fly. (Proceedings of the Boston Society of Natural History, xvi., 1874.) 8vo, pp. 14.

In the first place, is the common house fly of America the same as that of Europe? After a careful comparison of a number of individuals from Switzerland with many native examples, no difference could be found. How long it has been living in this country there are no data to show, and it may have been a passenger on the Mayflower, or buzzed in the cabin of Captain John Smith's vessel, or even performed its measured flight near the ceilings in the ancient town of Pemaquid.

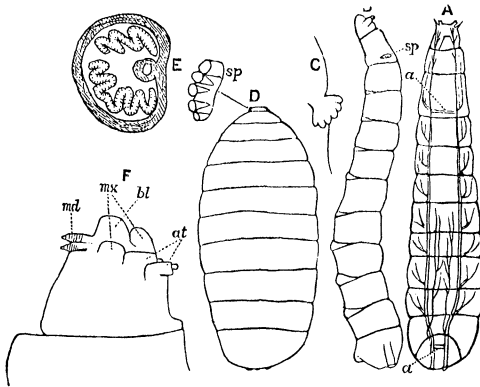
During the month of August the house fly is particularly abundant, and especially so in the neighborhood of stables. On placing a fly in a glass bottle, she laid, between six P. M., August 12th, and eight the next morning, one hundred and twenty eggs. They were deposited irregularly in stacks, lying loose in two piles at the bottom of the bottle. At eight in the morning of August 14th several were found hatched out and crawling about the bottom of the bottle. But a greater number of young were desired for purposes of study, and an abundance of food in which to rear them. A mass of freshly-dropped horse manure, still warm, was placed at an open window in the sun. This, with fresh masses added from time to time, attracted numbers of flies for three or four weeks succeeding, which laid eggs during that period, so that thousands of young in different stages of development were obtained.

Immediately after exposing the manure on the morning of August 12th, the flies appeared, and, penetrating down, often out of sight, deposited bunches of eggs in convenient crevices. The egg of the house fly is long, slender, cylindrical, and a little smaller at the anterior end than at the other. It is .04-.05 of an inch long and about one quarter as thick. The shell is so dense that the early embryonic phases could not be watched, but enough was seen to enable us to determine that the mode of growth in the egg is nearly the same as that of the flesh fly, as observed by Dr. Weismann.

The eggs thus laid were found to hatch twenty-four hours later. In confinement they required from five to ten hours more, and the maggots hatched in confinement were smaller than those reared from eggs deposited in warm manure. Certain worms reared also in too dry manure were nearly one half smaller than those bred in more favorable circumstances. For several days the worms living in this dry manure did not grow sensibly. Too direct warmth, but more especially the want of sufficient moisture, and consequently of available semi-liquid food, seemed to

cause them to become dwarfed. It is evident that heat and moisture are required for the normal development of the fly, as they are for nearly all insects.

The maggot molts twice, consequently there are three stages of development, and it becomes sensibly larger at each stage. After remaining in the first stage for one day it molts, and differs from the preceding stage only in being a little larger, and in the addition of the spiracle near the head (Figure 28, B, *sp.* C, the same enlarged.) After remaining in this stage from twenty-four to thirty-six hours it sheds its skin and enters upon the third stage, which lasts three or four days. Figure 28, A, B, represent the maggot; the body is long and slender, somewhat conical, the head and mouth-parts being rudimentary. The end of the body is truncated, and bears two short tubercles or spiracles. Figure 28, E, represents one of these circular breathing holes much enlarged, with three sinuous openings, the edges of which are



(FIG. 28.) EARLY STAGES OF THE HOUSE FLY.¹

armed with fine projections forming a rude sieve for the exclusion of dust and dirt. With these spiracles connect the two main tracheæ, communicating by two cross branches (*a*) and sending off numerous twigs. The young of the house fly differs chiefly from that of the flesh fly in being only one half as large, while the form of the openings in the spiracles at the end of the body is entirely different.

When about to transform into the pupa or chrysalis state the

¹ A, larva of *Musca domestica*, just hatched, showing the distribution of the two main tracheæ, and the anterior and posterior commissures (*a*, *a*), dorsal view. B, the larva in the second stage; *sp*, spiracle. C, spiracle enlarged. F, head of the same larva, enlarged; *bl*, labrum (?); *md*, mandibles; *mx*, maxillæ; *at*, antennæ. E, a terminal spiracle much enlarged. D, puparium; *sp*, spiracle. All the figures much enlarged.

body contracts into a barrel-shaped form, as seen in Figure 28, D, turns brown and hard, forming a case (puparium) within which the body of the larva transforms into that of the pupa. Weismann has made the discovery that in the larval flesh fly when about to transform into the pupa state, the head and thoracic segments die, and that the head and thorax of the pupa arise from minute disks attached to the smaller nerves or tracheæ in the body of the worm. This is paralleled by the metamorphosis of the "pluteus" into the adult starfish, and is a much more complete metamorphosis than even that of the caterpillar into the chrysalis of the butterfly.

Our house fly having as a maggot lived a life of squalor, immersed in its revolting food, with its new change of form, involving the death of one half its body and the origin of a new head and thorax, with legs and wings, eyes, feelers, and mouth-parts; after a short pupal sleep of from five to seven days pushes off one end of its pupa case, and appears winged, with legs where before there were no traces of feet, and is animated by new instincts and mental traits. It is difficult to realize how striking are the changes, physical and psychological, which the house fly undergoes in the transition from the maggot to the volant, cursorial being which puts a girdle, like Puck, around its little world, — the dining-room or parlor, — and like its mischievous prototype plays all sorts of antics, tasting the sugar, lapping the molasses, now tickling the nose of the sleeping housewife resting from her pre-prandial toils, or adjourning to the library and scraping with its spiny tongue the rich binding of the bookworm's treasures.

If in its winged condition it is one of the most disagreeable features of dog-days, and people wonder why flies were ever made at all, it should be remembered that flies have an infancy as maggots, and the loathsome life they then lead as scavengers cleanses and purifies the August air, and lowers the death-rate of our cities and towns. Thus, while stables and piggeries and filth are tolerated by city and town authorities, the young of the house fly and the flesh and blow fly, with their thousand allies, are doing something towards purifying the pestilential air, and averting the summer brood of cholera, dysentery, diphtheria, typhus and typhoid fever, which descend like harpies upon the devoted towns and cities. It may be regarded as an axiom that where flies most abound there filth, death-dealing and baneful, is most abundant, and filth-diseases such as we have named most do congregate.

As we have said, when the fly leaves its pupa-case it pushes away the front end of the case, which opens like a lid, by means of the distention of the membranous front of the head, which may be seen pushing out and in as the fly walks rapidly about. This bladder-like expansion is evidently distended with air and in connection with the air-tubes within the body, so that it may serve the temporary purpose of enabling the fly to disengage itself from its pupa-case. When free from its prison the fly walks or rather runs nervously about, as if laboring under a good deal of mental excitement, and quite dazed by the new world of light and life about it, for as a maggot it was blind, deaf, and dumb. Now its wings are soft, small, baggy, and half their final size. The fluid that fills them soon, however, dries up, the skin of the fly attains the colors of maturity and it soon flies off with a buzz suggestive of contentment and light-heartedness born of its mercurial temperament. That the fly not only throws off in its buzz songs of the affections, love ditties, but also may vary its notes accordingly as it is elevated or depressed in spirits concerning more trivial and less absorbing matters, we are assured by Sir John Lubbock, who says that the sounds of insects do not merely serve to bring the sexes together; they are not merely "love songs," but also serve, like any true language, to express the feelings.

The life of the house fly may, then, be summed up as follows: It lives one day in the egg state, from five days to a week as a maggot, from five to seven days in the pupa state, — in all, from ten to fourteen days in the month of August, — before the winged adult period. It is often asked how long-lived a fly is. Most of the flies which are born in August live for a month or six weeks, and die at the coming of frost, either of cold or from the attacks of fungoid plants. A few probably winter over and survive until midsummer, and thus maintain the existence of this useful species, to which civilized man owes more than he can readily estimate, and with which he can dispense only when the health of our cities and towns is looked after with far greater vigilance and intelligence than is perhaps likely to be the case for several centuries to come.